



Carbon and greenhouse gas balance of a temperate pine afforestation chronosequence

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We determined the carbon (C) and greenhouse gas (GHG) balance for an age-sequence of four (7, 20, 35, and 70 years old) afforested white pine (*Pinus strobus* L.) forests in southern Ontario, Canada. The annual net ecosystem production (NEP) derived from biometric and eddy-covariance (EC) data was combined with estimates of the dissolved organic carbon (DOC) export to obtain the annual net ecosystem carbon balance (NECB). Static chamber measurements of methane (CH₄) and nitrous oxide (N₂O) fluxes were conducted throughout the snow free periods. The average contribution of DOC export to the NECB decreased from 8% at the 7-year old stand to <1% at the three older stands. The combined contribution from exchanges of CH₄ and N₂O to the global warming potential (GWP) was estimated at 9% in the 7-year old stand and at 5% in the mature 70-year old stand indicating a significant contribution to the GHG balance of temperate pine forests in early and late development stages. In the two middle-aged stands however, this contribution was <1% and integrated over the entire succession period, the GWP of these forests was driven by the CO₂ exchange. Furthermore, our results indicate a large potential for net C sequestration through afforestation of marginal agricultural land ranging between 130 t C ha⁻¹ for low-productive stands to 250 t C ha⁻¹ in high productive pine stands over a period of 70 years.